Development of an MR-compatible SPECT system (MRSPECT) for simultaneous data acquisition.

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Public Summary:
In medical imaging, single-photon emission computed tomography (SPECT) can provide specific functional information while magnetic resonance imaging (MRI) can provide high spatial resolution anatomical information as well as complementary functional information. In this study, we developed a miniaturized dual-modality SPECT/MRI (MRSPECT) system and demonstrated the feasibility of simultaneous SPECT and MRI data acquisition, with the possibility of whole-body MRSPECT systems through suitable scaling of components. For our MRSPECT system, a cadmium-zinc-telluride (CZT) nuclear radiation detector was interfaced with a specialized radiofrequency (RF) coil and placed within a whole-body 4 T MRI system. Various phantom experiments characterized the interaction between the SPECT and MRI hardware components. The metallic components of the SPECT hardware altered the B(0) field and generated a non-uniform reduction in the signal-to-noise ratio (SNR) of the MR images. The presence of a magnetic field generated a position shift and resolution loss in the nuclear projection data. Various techniques were proposed to compensate for these adverse effects. Overall, our results demonstrate that accurate, simultaneous SPECT and MRI data acquisition is feasible, justifying the further development of MRSPECT for either small-animal imaging or whole-body human systems by using appropriate components.

Scientific Abstract:
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